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## NATIONAL CHANGES IN HEALTH AND LONGEVITY\*

BY ARTHUR NEWSHOLME

The subject roughly indicated in the title as announced evidently cannot be even outlined in an hour's address; my remarks will deal chiefly with some of the changes in longevity in England and, so far as they are ascertainable, in this country. After a more general introduction, I propose to confine my review to men, merely indicating that improvements in the male have in nearly every instance been exceeded in the female sex. As will be seen shortly, I propose, furthermore, to limit my comparisons chiefly to the period beyond the 40th year of human life.

It will be agreed that the object of preventive medicine is to secure long life with enhanced health. The mere desire for long life may, from a certain angle, be regarded as including some ignoble elements. There is a sense in which we must agree with the Wisdom of Solomon:

"Honorable age is not that which standeth in length of time, nor is measured by number of years. He being made perfect in a short time fulfilled a long time."

Although it is the desire of every man to die of old age, there are many passions more powerful. As Lord Bacon said:

"There is no passion in the mind of man so weak, but it mates and masters the fear of death. . . . Revenge triumphs over death; love slights it; honor aspires to it; grief flyeth to it; fear pre-occupateth it."

But to die of old age is the laudable ambition of all. We may assume that death is a normal, though the last, act of life. In Goethe's words, "Life is the most exquisite invention of nature, and death is her expert contrivance to get plenty of life."

To die of age is comparatively rare. Disease and accident, in times of peace, are the chief causes of death in civilized communities; premature and therefore wasteful death is the rule among us. This is illustrated by the following table, which shows in various life-table experiences the age at which a given number (say 100,000) starting at birth becomes reduced to half its original size (say 50,000).

It is convenient here to explain for the benefit of non-technical readers that a life table represents "a generation of individuals passing through time." Theoretically, it may be formed by actually watching

\*A lecture delivered before the Harvey Society, Jan. 29, 1921.

a large group of persons from birth to death, and ascertaining the number of survivors and the average future expectation of life at each successive birthday. But such a life table would be obsolete before it could be utilized; and in the life-table figures quoted hereafter, the death rates for each age-period of life during a short series of years are assumed to determine the number of survivors to the next age-period, who are then subject to the death rate of the next age-period in the same years, and so on.

TABLE I  
AGE AT WHICH POPULATION IS REDUCED TO ONE-HALF POPULATION AT BIRTH  
(LIFE-TABLE EXPERIENCE)

	Experience of	Males	Females
England and Wales . . . . .	1901-10	58-59 years	62-63 years
" " . . . . .	1909-11	61-62 "	65-66 "
United States of America:			
Experience of . . . . .	1909-11		
Entire population . . . . .	Original registra- tion states	58-59 years	62-63 years
White . . . . .	"	59-60 "	63-64 "
Negro . . . . .	"	34-35 "	40-41 "
Native white . . . . .	"	60-61 "	64-65 "
White in cities . . . . .	"	55-56 "	60-61 "
White, rural . . . . .	"	65-66 "	67-68 "
Indiana . . . . .	"	64-65 "	66-67 "
Massachusetts . . . . .	"	58-59 "	62-63 "
Michigan . . . . .	"	64-65 "	66-67 "
New Jersey . . . . .	"	57-58 "	62-63 "
New York . . . . .	"	55-56 "	61-62 "

Dr. Farr (35th Ann. Rep. of Reg. General) described the age between 45 and 55 as the middle arch of life, since shortly after the 45th year of age, a million born at the same time were reduced to half a million. Now a much larger proportion pass this middle arch of life.

In most of the communities mentioned, half of the total population born has scarcely disappeared before reaching the 60th annual turnstile.

This is true for a life-table population in which a given number of persons are traced through life on a fixed basis of experience. In actual life there is in most communities a greater stream of incoming

TABLE II  
ENGLAND AND WALES, 1901-10  
PROPORTION OF DEATHS AT ALL AGES (=100) AT DIFFERENT AGE-PERIODS

Age	Males	Females
First 5 years . . . . .	35.0	31.0
Twenty years 5-25 . . . . .	7.8	8.3
" " 25-45 . . . . .	12.6	12.2
" " 45-65 . . . . .	20.8	19.1
Ages 65 and upwards . . . . .	23.8	29.4
	100.0	100.0

new lives by birth than of departing lives; the loss of life under these circumstances is heaviest in the earlier years of life. This is illustrated in Table II, which gives the proportion of deaths at all ages that occurred at different age-periods in England and Wales during the years 1901-10.

Thus, in actual experience only 44.6 per cent of the male and 48.5 per cent of the female deaths occur at ages over 45.

#### THE VITAL SUPERIORITY OF THE FEMALE

It will be noted that a smaller proportion of female than of male deaths occur in early life; also that on the average females live longer than males. The following table shows that at every age except the age between 5 and 15, the female death rate is lower than that of the male at corresponding ages.

TABLE III  
PERCENTAGE EXCESS OF MALE OVER FEMALE DEATH RATE AT EACH AGE-PERIOD DURING TWO DECENNIA\*

Age	1851-60	1901-10
0-.....	+15	+19
5-.....	+1	-3
10-.....	-3	-5
15-.....	-9	+7
20-.....	+4	+19
25-.....	-4	+17
35-.....	+3	+22
45-.....	+18	+30
55-.....	+14	+28
65-.....	+11	+20
75 and upwards.....	+6	+12

\* This table and most of the other tables given in this paper are derived from Dr. Stevenson's contributions to the Reports of the Registrar General of England and Wales.

The death rate at every age in both sexes has declined, but males show an increasing excess of mortality as compared with females, amounting to a maximum excess of 30 per cent at the age-period of 45-55. The excess of female over male mortality at ages 5-15 in 1901-10 and at ages 10-15, which has held good during seven consecutive decennial periods of English experience, would form an admirable subject for further study. Except at these ages the superiority of female over male vitality is evident throughout life—a fact which is perhaps too little known.

In England and Wales, for every 1,000 live-births of female infants there were 1,049 live-births of male infants in 1841-50, the proportion slowly falling to 1,038 in 1901-10, and rising again to 1,045 to every 1,000 female births in the three years 1916-18.

In the birth registration area of the United States in 1918 the pro-

portion of male to female live-births was 1,059 to 1,000 among the white, and 1,020 to 1,000 among the negro population.

But this excess of males over females is soon removed. The superiority of the female in the struggle for survival is shown markedly in the first day after live-birth, through every week of the first month, and in each trimester of the first year of extra-uterine life; and it is shown in American and in English experience alike. By the end of the second year of extra-uterine life, girls outnumber boys. That greater facility of birth of females owing to a smaller cranium is not the sole cause is evidenced by the persistence of the phenomenon of superior vitality.

TABLE IV  
DEATH RATE AT EACH PERIOD OF INFANCY PER 1,000 BIRTHS

	England and Wales, 1918		United States, birth registration area, 1918	
	Males	Females	Males	Females
Under one day . . . . .	12.6	9.6	17.6	13.1
1 day and under 1 week . . . . .	13.3	10.7	17.0	13.1
2nd week . . . . .	6.0	4.9	6.5	5.4
3rd " . . . . .	5.2	3.8	4.8	3.9
4th " . . . . .	3.9	2.8	3.7	3.1
Total under 1 month . . . . .	41.0	31.8	49.6	38.6
1 to 3 months . . . . .	18.9	15.0	17.1	13.7
3 to 6 " . . . . .	18.1	13.6	17.9	14.5
6 to 9 " . . . . .	15.6	12.6	14.5	12.7
9 to 12 " . . . . .	14.3	13.0	11.7	11.1
	107.9	86.0	110.8	90.6

DEATH RATES AT DIFFERENT AGES: INCREASES AND DECREASES

For the registration area of the United States, comparisons are possible only between 1900 and subsequent years. In Table V the American experiences for the single years 1900 and 1911 are quoted from the Mortality Statistics, 1911 (Bureau of Census), page 22. The death rates for the same years and ages are given for England and Wales.

TABLE V  
MALES: DEATH RATE PER 1,000 LIVING AT EACH AGE

Year	0-	5-	10-	15-	20-	25-	35-	45-	55-	65-	75 and over
1900 England and Wales . . . . .	61.6	4.2	2.3	3.7	5.1	6.7	11.7	19.9	37.1	74.2	168.3
United States reg. area . . . . .	54.2	4.7	2.9	4.9	7.0	8.3	10.8	15.8	28.9	59.6	146.1
1911 England and Wales . . . . .	46.2	3.5	2.0	3.0	3.9	5.0	8.0	14.8	29.7	63.5	150.4
United States reg. area . . . . .	39.8	3.4	2.4	3.7	5.3	6.7	10.4	16.1	30.9	61.6	147.4

The differences are interesting, but it is desirable to compare the experience of other years before final conclusions are drawn. In 1900, at ages 0-5 and at all ages over 35, registration America had a more favorable male death rate than England; in 1911 its superiority at higher ages was confined to ages over 65. In 1900 the English death rate at ages 0-5 was 14 per cent and in 1911 was 16 per cent higher than that of America (registration area). Evidently, then, in view of the higher infant mortality in America, the death rate at ages over 1 and under 5 is lower in the United States than in England, a subject worthy of further study. For all ages the standardized death rate of England and Wales was 19.9 per 1,000 population in 1900, and 15.6 in 1911; in the original registration area of the United States it was 17.6 in 1900, and 15.3 in 1911; there being a 22 per cent improvement in England, and a 13 per cent improvement in the registration area.

#### THE INCIDENCE OF REDUCED DEATH RATE AT DIFFERENT AGES

In the next table is shown the historical trend of the death rates of England and Wales in five successive decennial periods, the increase or decrease of the death rate for various age groups being displayed.

TABLE VI

INCREASE OR DECREASE PER CENT OF THE DEATH RATE FOR EACH SEX AND AGE-GROUP COMPARED WITH THE DEATH RATE FOR THE SAME GROUP IN THE IMMEDIATELY PRECEDING DECENNIUM

	England and Wales				United States
	1871-80 compared with 1861-70	1881-90 compared with 1871-80	1891-1900 compared with 1881-90	1901-10 compared with 1891-1900	1911 compared with 1900
<b>Males</b>					
under 5 . . . . .	-6.9	-10.0	+1.8	-20.2	-26.6
5 . . . . .	-18.1	-20.3	-19.4	-18.7	-27.7
10 . . . . .	-17.3	-20.4	-17.1	-16.1	-17.2
15 . . . . .	-15.1	-17.8	-12.2	-18.5	-24.5
20 . . . . .	-13.1	-22.1	-11.7	-17.4	-24.3
25 . . . . .	-6.0	-16.9	-13.0	-17.6	-19.3
35 . . . . .	+2.3	-10.2	-7.2	-20.4	-3.7
45 . . . . .	+4.2	-3.5	-2.2	-14.4	+1.9
55 . . . . .	+5.2	-0.5	+0.7	-9.0	+6.9
65 . . . . .	+3.9	+1.1	-0.1	-7.9	+3.4
75 and over .	+2.3	-3.9	-1.6	-4.8	+0.9
<b>Females</b>					
under 5 . . . . .	-8.4	-11.0	+1.6	-20.7	-27.3
5 . . . . .	-20.1	-15.6	-16.9	-17.3	-32.6
10 . . . . .	-17.5	-16.4	-17.5	-15.6	-32.3
15 . . . . .	-17.9	-18.9	-17.1	-21.1	-31.3
20 . . . . .	-14.6	-18.7	-19.5	-21.6	-29.9
25 . . . . .	-11.4	-14.4	-17.5	-22.0	-26.8
35 . . . . .	-3.6	-9.0	-9.4	-21.5	-15.3
45 . . . . .	-0.2	-3.3	-2.4	-15.1	-9.2
55 . . . . .	+2.7	-0.7	-0.1	-12.6	+0.8
65 . . . . .	+3.2	-1.0	+0.5	-11.2	+2.4
75 and over .	+0.8	-5.2	-1.1	-7.0	-0.2

The table shows also a similar comparison between the experience of 1911 and 1900 for the registration area of the United States.

It will be noted that the American experience displays for the later period an increased death rate in men at all ages over 45, and in women at ages 55 to 75.

When the experience of 1871-80 is contrasted with that of 1861-70, the English experience shows an increased death rate at all ages over 35 for males, and at ages over 55 for females. When 1881-90 is contrasted with 1871-80 there is no evidence of increased death rate at any age except in men aged 65-75; and the experience of the 20 years 1891 to 1910 shows a declining death rate in both sexes at all ages, with the exception of a slight increase at ages 55-65 in males and at ages 65-75 in females in 1891-1900, owing probably to the influenza pandemic of 1889-93. The evidence is definite that there has been steady advance in the age to which increasingly favorable death rates extend.

Thus, a comparison of the experience of (the death registration area of) the United States with that of England and Wales shows that the registration area stands historically in respect of increase or decrease of death rate at various stages of life approximately where England stood in 1871-80; and it is not very hazardous to make the same forecast for the United States that I ventured to make for England in the year 1893 when the first *Brighton Life Table* was prepared by me.\* In that publication, I pointed out that:

"It is evident that although in England, owing to the large number of lives saved during the early years of life, the number surviving to the higher ages has increased, thus securing a great gain to the community, this is not incompatible with a stationary or even diminished prospect of life for each individual over a certain age. In England the death rate for males was higher in 1871-80 for *all age-groups above the 25-35 period*, and for females was higher in 1871-80 for *all age-groups above the 35-45 period* than in preceding decennial periods."

After discussing the influence of increased wages and improved nutrition in more than counterbalancing the unfavorable influence of city conditions of life, I laid stress on the following factor which must, I believe, be given a large share of the credit for the reduced death rate at older as well as at younger ages which has now been realized.

"Another consideration requires to be borne in mind. We are at present in a transition period. The Public Health Acts of 1871 and 1875 heralded immense improvements in sanitation, the fruits of which have not yet been fully reaped. There has been, more especially since 1875, steady and increasing improvements in the conditions under

\* See also p. 316 of the author's *Elements of Vital Statistics*, 1899.

which people live. Men now 40 years of age were born in the pre-sanitary period; and the first 20 years of their life were spent under more unhygienic conditions than those now holding good. This fact would go far towards explaining a stationary death rate at the higher ages. It does not, however, explain an increased death rate at those ages.

The explanation of this increased death rate at the higher ages will probably be evident when at the end of another 20 or 30 years the improved conditions of life have endured sufficiently long to enable their full force and value to be determined. We must be content in the meantime to have stated the more important factors which appear to be at work, leaving the complete solution of the problem to a time when the statistical experience of our country is more mature."

At the end of the time asked for in the foregoing comment, it is noteworthy that at every age, even beyond 75 years of age, the number dying for a given number at risk has decreased; and the improved conditions of modern life, sanitary, social, and economic, have resulted in England in a lowered death rate at every recorded age-period.

It is unfortunate that a similar comparison can be made for the registration area of the United States only for 1900 and 1911; which, as already stated, displays a difference similar to the one displayed when the English death rates at different ages in 1871-80 are compared with corresponding death rates for 1861-70.\*

#### CHANGES IN ADULT MORTALITY

Having given a brief outline of the general lowering of the death rate at every period of life and having shown the greater share of women in this improvement, I propose now to confine my observations to the historical changes after the age 25, and more particularly to events after the 40th milestone of life has been passed, as it is especially concerning this period of life that our professional pessimists—as always in the past—insist that we are "going to the dogs."

\* This statement gives the historical position. It will be noted, however, that the standardized total American death rate in 1911 was 15.3 as compared with 15.6 for England and Wales. I am able to give the following additional contribution to the historical position. In the annual report of the Massachusetts Board of Health for 1896 is given a comparison of the death rate according to age for both sexes in combination in 1875 and 1895 respectively.

DEATH RATE, MASSACHUSETTS, U. S. A.

	0-	5-	10-	15-	20-	30-	40-	50-	60-	70-	80-
1875.....	73.9	9.8	4.7	7.7	10.5	11.3	13.0	18.3	34.8	71.1	176.4
1895.....	64.5	6.2	3.2	5.3	7.1	9.7	12.7	20.5	39.4	82.4	184.7

It will be noted that the death rate had increased between 1875 and 1895 at each age-period after 50. A somewhat similar increase has occurred between 1900 and 1911.



It is particularly unfortunate that these historical comparisons, owing to the absence of comparable American data, must for the present be limited chiefly to English experience with a relatively stable population and long experience of accurate vital statistics. For England and Wales as a whole, a consecutive series of life tables makes possible comparisons for a long series of years. In the following tables the facts are shown for males.

TABLE VII  
LIFE TABLES FOR MALES  
A—NUMBER OF SURVIVORS AT HIGHER AGES, OUT OF 1,000 BORN

Experience of	England and Wales				Massachusetts, U. S. A.	
	1838-54	1881-90	1901-10	1910-12	1893-97	1909-11
No. at birth . . . . .	1,000	1,000	1,000	1,000	1,000	1,000
No. at age						
25 . . . . .	624	694	745	779	680	760
30 . . . . .	595	669	727	762	651	739
35 . . . . .	564	640	705	742	620	713
40 . . . . .	532	605	677	717	588	683
45 . . . . .	496	564	642	685	554	646
50 . . . . .	456	518	599	643	515	604
55 . . . . .	409	463	544	590	468	551
60 . . . . .	356	398	476	521	411	482
65 . . . . .	295	322	393	435	344	395
70 . . . . .	223	239	299	334	267	296
75 . . . . .	148	154	198	224	185	197

B—NUMBER OF SURVIVORS AT HIGHER AGES OUT OF 1,000 AT AGE 25

No. at age	England and Wales				Massachusetts, U. S. A.	
	1,000	1,000	1,000	1,000	1,000	1,000
25 . . . . .						
30 . . . . .	954	964	976	978	958	972
35 . . . . .	904	922	946	952	912	938
40 . . . . .	852	872	909	920	865	899
45 . . . . .	794	813	862	879	815	850
50 . . . . .	731	746	804	826	758	795
55 . . . . .	655	667	730	758	688	725
60 . . . . .	570	574	639	669	604	634
65 . . . . .	473	464	528	558	506	520
70 . . . . .	357	344	401	429	393	389
75 . . . . .	237	222	266	288	272	259

C—NUMBER OF SURVIVORS AT HIGHER AGES OUT OF 1,000 AT AGE 40

No. at age	England and Wales				Massachusetts, U. S. A.	
	1,000	1,000	1,000	1,000	1,000	1,000
40 . . . . .						
45 . . . . .	932	932	948	956	942	946
50 . . . . .	857	856	885	897	876	884
55 . . . . .	769	765	804	823	796	807
60 . . . . .	669	658	703	727	699	706
65 . . . . .	556	532	580	606	585	578
70 . . . . .	420	395	442	466	454	433
75 . . . . .	278	255	291	312	315	288

Table VII A shows that in each successive life table the number of survivors to the age 25, out of equal numbers born, has continuously increased with lapse of time. The subsequent course of events for adult life can more accurately be followed in Table VII B. It will be seen that with the exception of ages 60 and upwards, in the decennium 1881-90, the number of survivors out of every 1,000 reaching the age of 25 years has steadily increased until after the Psalmist's term of life is passed. Similarly, out of every 1,000 reaching 40 years of age (Table VII C), with the exception of ages 55 and upwards, in 1881-90, improvement in expectation of life is shown at all ages over 40. These tables give no evidence of national deterioration at higher ages. They show, on the contrary, increased longevity in each succeeding period. This is further illustrated in Figure I.

For the United States death registration area\* historical comparisons are practicable only for 1900 onward, except for Massachusetts, for which Dr. S. W. Abbott, the secretary of the then State Board of Health, constructed a life table based on the experience of the years 1893-97,† the data for which are probably comparable with those for Massachusetts published in the life-table volume of the Federal Census Bureau. In this volume is given *inter alia* a life table for Massachusetts, based on the experience of 1909-11; and in Table VII these two experiences are compared.

When the whole of life is taken into account the results in Massachusetts show improved prospects of life in every age-period; so in the main do the figures for equal numbers starting at age 25; but for equal numbers starting at age 40, there appears to be slight vital deterioration from age 65 and upwards.

Although the material for historical comparisons in the United States is scanty, the series of life tables issued by the Bureau of the Census, based on the deaths in the three years 1909-11 and the population of 1910, gives valuable material for almost contemporaneous comparison with the data for England and Wales. Dr. William H. Davis, the chief statistician for vital statistics of the Census Bureau, informs me that the English and the American life tables are comparable with respect to methods of construction. In Table VIII are compared the number of survivors out of 1,000 males at birth, at age 25, and in each successive five additional years of age. The columns are arranged in order of the number of survivors to the highest age, beginning with the experience of greatest vitality.

\* This area comprised in 1900, 40.5 per cent of the total population of the United States.

† The 30th Annual Report of the State Board of Health of Massachusetts for 1898 gives also an earlier life table for persons in Massachusetts dealing with the experience of the year 1855.

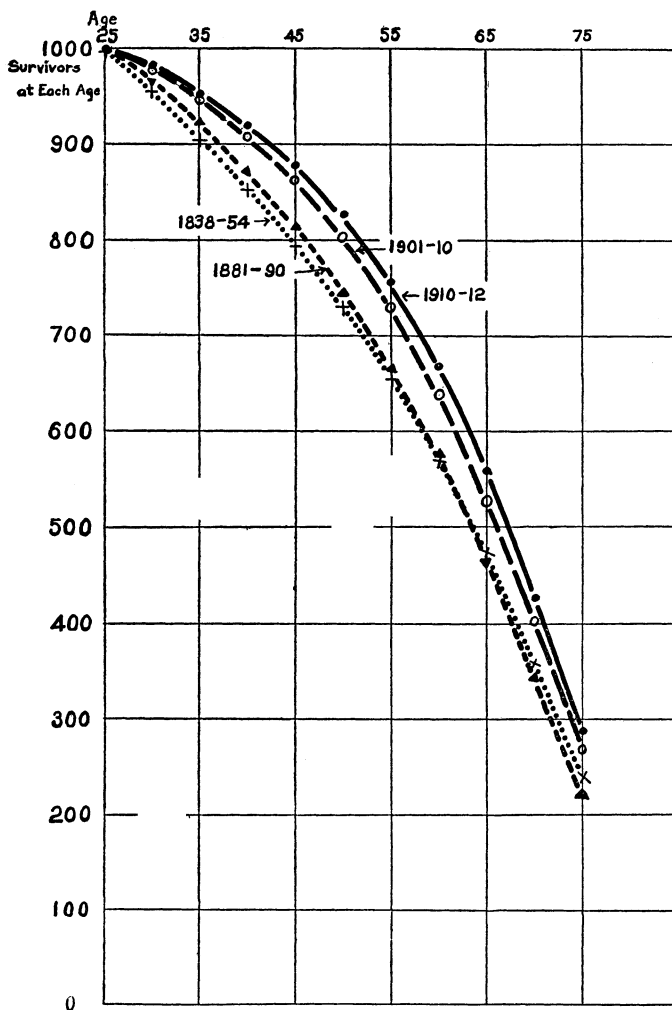


FIGURE 1. LIFE TABLE EXPERIENCE, ENGLAND AND WALES, FOR FOUR PERIODS. Number of male survivors at each subsequent age out of 1,000 at age 25, in 1838-54, 1881-90, 1901-10, and 1910-12.

It will be noted that the aggregate white males in the rural parts and in the whole of the registration area, and the population of the states of Indiana and Michigan showed the largest number of survivors to age 25, Michigan coming next.\*

In Figure II the relative experience of urban and rural populations and of Massachusetts is shown.

\* Separate life tables have been published for Indiana, Massachusetts, Michigan, New Jersey, and New York.

TABLE VIII  
UNITED STATES LIFE TABLES, 1909-11, FOR MALES  
A—NUMBER OF SURVIVORS AT HIGHER AGES OUT OF 1,000 BORN

	Total white males (rural parts)*	Native- born white males*	Total white males*	White males in cities*	Indi- ana	Michi- gan	New Jersey	New York	Massa- chusetts
No. at birth.	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
No. at age									
25.....	806	768	770	751	804	791	764	756	760
30.....	785	744	748	728	782	771	741	731	739
35.....	763	716	721	698	757	749	712	701	713
40.....	738	683	688	662	732	725	677	662	683
45.....	710	648	651	619	702	698	637	619	646
50.....	677	608	607	569	667	663	591	569	604
55.....	637	561	556	510	628	621	537	511	551
60.....	581	501	490	435	570	565	466	440	482
65.....	506	426	409	347	498	489	381	358	395
70.....	409	337	315	253	404	393	288	269	296
75.....	294	237	216	162	290	279	194	180	197

B—NUMBER OF SURVIVORS AT HIGHER AGES OUT OF 1,000 AT AGE 25

No. at age	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
25.....									
30.....	974	969	971	969	973	975	970	967	972
35.....	946	932	936	929	942	947	932	927	938
40.....	916	889	894	882	911	917	886	876	899
45.....	881	844	846	824	873	882	834	819	850
50.....	840	792	788	758	830	838	774	753	795
55.....	790	731	722	679	781	785	703	676	725
60.....	721	652	636	579	709	714	610	582	634
65.....	628	555	531	462	619	618	499	474	520
70.....	507	439	409	337	503	497	377	356	389
75.....	365	308	280	216	361	353	254	238	259

C—NUMBER OF SURVIVORS AT HIGHER AGES OUT OF 1,000 AT AGE 40

No. at age	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
40.....									
45.....	962	949	946	935	959	963	941	934	946
50.....	917	890	882	860	911	915	873	859	884
55.....	863	821	808	770	858	857	793	772	807
60.....	787	734	712	657	779	779	688	664	706
65.....	686	624	595	524	680	675	563	540	578
70.....	554	493	458	382	552	542	426	406	433
75.....	398	347	314	245	396	385	287	272	288

\* In the original registration states.

The picture is not materially changed when the survivorship of 1,000 men starting at age 40 in each of these states is contrasted. The populations living preponderantly in cities evidently occupy an inferior position. That the conditions of city life explain, largely at least, the marked differences of vitality in the different states is suggested by the partial coincidence between degree of urbanization and paucity of survivors. At the census of 1910, 92.9 per cent of the population in Massachusetts was urban (*i. e.*, lived in districts with a population exceeding 2,500); 78.9 per cent in New York and 75.2 per cent in New

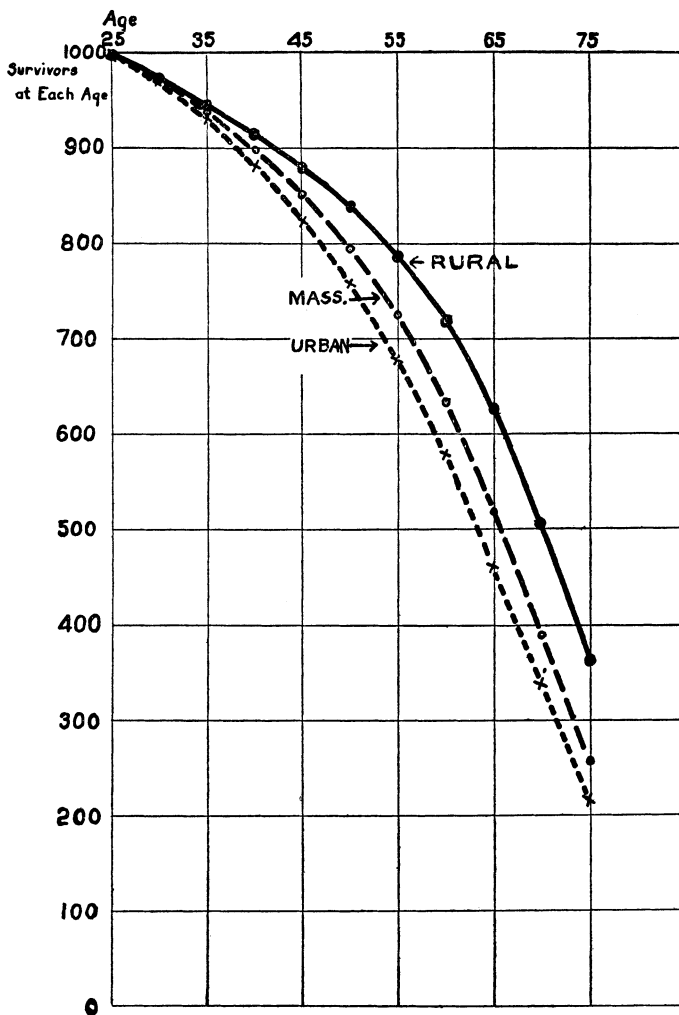


FIGURE II. LIFE TABLE EXPERIENCE OF THE UNITED STATES (1909-11). Number of male survivors at each subsequent age out of 1,000 at age 25 in the aggregate urban and rural white populations of the original registration states and in Massachusetts.

Jersey, as against 47.2 per cent in Michigan and 42.5 per cent in Indiana. The proportion of foreign-born population in 1910 was about 32 per cent in Massachusetts and New York State; 29.5 per cent in New Jersey; 22.1 per cent in Michigan; and 9.2 per cent in Indiana. It may be added that for every 100 foreign-born persons in Massachusetts the highest proportion is Irish (21.2 per cent); in New York

the greatest number are Russians (20.5 per cent), followed by Italians (17.5 per cent) and Germans (16.0 per cent).

If the experiences from age 25 onward be compared, rural males, the males of Michigan and of Indiana have approximately an equal number of survivors to the age 70, while Massachusetts, New Jersey, and the State of New York have relatively few.

Table IX compares the experience of males in England and Wales in 1910-12 with that of white males and of white native-born males in the registration area of the United States in 1909-11.

TABLE IX  
A—NUMBER OF SURVIVORS AT HIGHER AGES OUT OF 1,000 BORN

	England and Wales	United States* 1909-11	
	Males 1910-12	All native-born white males	All white males
No. at birth.....	1,000	1,000	1,000
No. at age			
25.....	779	768	771
30.....	762	744	748
35.....	742	716	721
40.....	717	683	688
45.....	658	648	651
50.....	643	608	607
55.....	590	561	556
60.....	521	501	490
65.....	435	426	409
70.....	334	337	315
75.....	224	237	216

B—NUMBER OF SURVIVORS AT HIGHER AGES OUT OF 1,000 AT AGE 25

No. at age			
25.....	1,000	1,000	1,000
30.....	978	969	971
35.....	952	932	936
40.....	920	889	894
45.....	879	844	846
50.....	826	792	788
55.....	758	731	722
60.....	669	652	636
65.....	558	555	531
70.....	429	439	409
75.....	288	308	280

C—NUMBER OF SURVIVORS AT HIGHER AGES OUT OF 1,000 AT AGE 40

No. at age			
40.....	1,000	1,000	1,000
45.....	956	949	946
50.....	897	890	882
55.....	823	821	808
60.....	727	734	712
65.....	606	624	595
70.....	466	493	458
75.....	312	347	314

\* Original registration states.

## SUMMARY

The close similarity between the experience of the male population in adult life in England and in the United States is striking. It is, further, noteworthy that the inclusion of foreign with native whites does not result in a very marked change in survivorship at the higher ages.

Summing up the teaching of the preceding tables we arrive at the following conclusions:

1. The vital experiences of England and Wales and of the death registration area of the United States are very similar, and almost equal.

2. At nearly all ages, including the first year of life, females have an intenser inherent power of survival than males; and females have profited more than males from the increased vitality at all ages in recent years.

3. English experience shows in successive decennial periods a reduction of death rate which encroaches on the higher ages with advance of time. After the end of the decennium 1881-90, with an insignificant exception, each age up to the end of life has shared in the reduced rate of mortality.

4. Stated in terms of survivorship, out of every 1,000 reaching 40 years of age, improvement in expectation of life (depending on the summation of survivors at all higher ages) is shown at all ages over 40, with the exception of ages over 55 in 1881-90.

5. This temporarily increased death rate at higher ages, which was probably associated with the influenza epidemic of 1889-93, has been followed by a marked decline of death rate at these higher ages.

6. In English experience the satisfactory result is shown of a diminishing death rate at all ages, though on a much greater scale in the younger than in the more advanced years of life.

7. A comparison of the life-table experiences of Massachusetts at an interval of twelve to fifteen years gives no evidence of vital improvement.

8. The current life-table experience of the white population of the United States (registration area) is almost identical with that of England; the male population (whites) of both countries have an almost equal chance of survival to the age 25; and for equal numbers starting at age 25 or at age 40, the native-born white population of America has a larger proportion of survivors to the age 75 than the population of England.

9. The position of the negro is lamentable, assuming that in the registration area of the United States the figures are trustworthy.\*

\* One thousand male negroes are reduced to one-half between their 34th and 35th birthday, while this does not happen for the white population before the 59th birthday is reached. I doubt whether

10. For the rural parts of the American population the expectation of life and the number of survivors to age 75 are much higher than in the entire registration area, while in cities and in the three states (New Jersey, New York, and Massachusetts) having a preponderantly city population, life is considerably curtailed.

#### INCREASE IN TOTAL DEATH RATE IN THE UNITED STATES AT AGES OVER 45

Three facts emerge prominently from the above study of American and English vital statistics: first, that in England there has for several decades been an almost continuous fall in the total death rate, affecting middle and advanced as well as early life; second, that the average positions of the white population of the United States (registration area) and of that of England are approximately equal; although, third, it appears that the male death rate at ages over 45 in the United States is still slightly increasing beyond what it was eleven years earlier. Why is this?

An explanation has already been suggested, if it be admitted that time is needed for the results of almost inseparable social and sanitary improvements to be felt at all ages. If, notwithstanding her vital position equal to that of England (owing, possibly, to the higher wages, better nutrition, and less alcoholism of the mass of the American as compared with the mass of the English population), she is still historically in the position as to age distribution of death rate occupied by England in 1871-80, when the older portion of the English population had not enjoyed in their childhood the social-sanitary betterment which their children enjoyed, then we may anticipate an extension of the reduced death rate in the United States to all ages ere long.

This view of the reason for the failure of the American population at the higher ages to share in the reduced death rates of earlier life is confirmed by the complex position of this country with respect to immigration. As already seen, nearly one-third of the population of the states of Massachusetts, New York, and New Jersey are foreign-born, and of the remaining two-thirds about half have foreign parent-

this figure can be trusted. Deficient birth registration among the negroes may have vitiated to some extent the life table estimates of negro population at ages 0-5, and increased the apparent death rate during this period. This would not, however, influence the number of survivors in a life-table population out of 1,000 males who reach age 25 as shown in the following table:

	Age										
	25	30	35	40	45	50	55	60	65	70	75
Total white pop. reg. area United States...	1,000	971	936	894	846	788	722	636	531	409	280
Negroes reg. area.....	1,000	938	865	787	704	614	516	413	309	213	130



age or mixed foreign and native parentage. These foreigners have come in varying proportions from Germany, Ireland, Italy, Russia, and Austria-Hungary, and in many cases they have in earlier life been constantly exposed to circumstances of malnutrition and insanitation; and, furthermore, in the earlier years of their residence in the United States they possibly have been subjected to excessive strain and privation in insanitary surroundings. It would be surprising if there were not a persistently high or even an increased death rate of persons at higher ages in the registration area. This subject has been elucidated statistically by Dr. Louis I. Dublin, who has shown that the foreign-born in New York and Pennsylvania experience a higher death rate than native-born of native parentage at nearly all older ages, and that this holds good also for native-born of foreign or mixed parentage.\*

#### THE REGISTERED INCREASED MORTALITY FROM SPECIAL DISEASES

Having arrived thus far, we are now able to consider the statements frequently made as to special causes of alleged increased mortality at higher ages. The following statement, based doubtless on official published figures, may be quoted as typical of numerous similar statements published in scientific journals and in the daily press.

"The death rate from degenerative diseases in the United States registration area has increased 41 per cent in 20 years. By this term is meant the wear-and-tear diseases such as cancer, arteriosclerosis, Bright's disease, etc., which are due to bad personal habits."

In examining the question as to whether this increase is real or apparent, or only partially real, we should remember the limitations of accuracy of medical certification of death. There has been steady improvement in medical certification, but this in itself has necessitated caution in accepting historical comparisons of diseases. The rule of safety in making historical comparisons is to confine such comparisons to individual diseases and not combine them into groups, as "circulatory," "renal," "nervous," and so on. The same rule applies, though to a lesser extent, when making contemporaneous comparisons. If I depart from this counsel of wisdom in what follows, it is to illustrate the dubiety attaching to the statistics thus displayed.

#### PNEUMONIA AND BRONCHITIS

Even for diseases like pneumonia and bronchitis there is some ambiguity in historical comparisons of statistics. There is not only change in medical fashions of certification, but also in one period a larger share of the pneumonia may be secondary to uncertified influenza, or of bronchitis or pneumonia to uncertified measles, than in another period. In

\* "The Mortality of Race Stocks in Pennsylvania and New York," by L. I. Dublin and G. W. Baker *Quar. Publ. of the Amer. Statist. Assoc.*, March, 1920.

the following curves the death rates from pneumonia and bronchitis in England and Wales among males at various ages over 25 for the two periods 1881-90 and 1901-10 are compared.

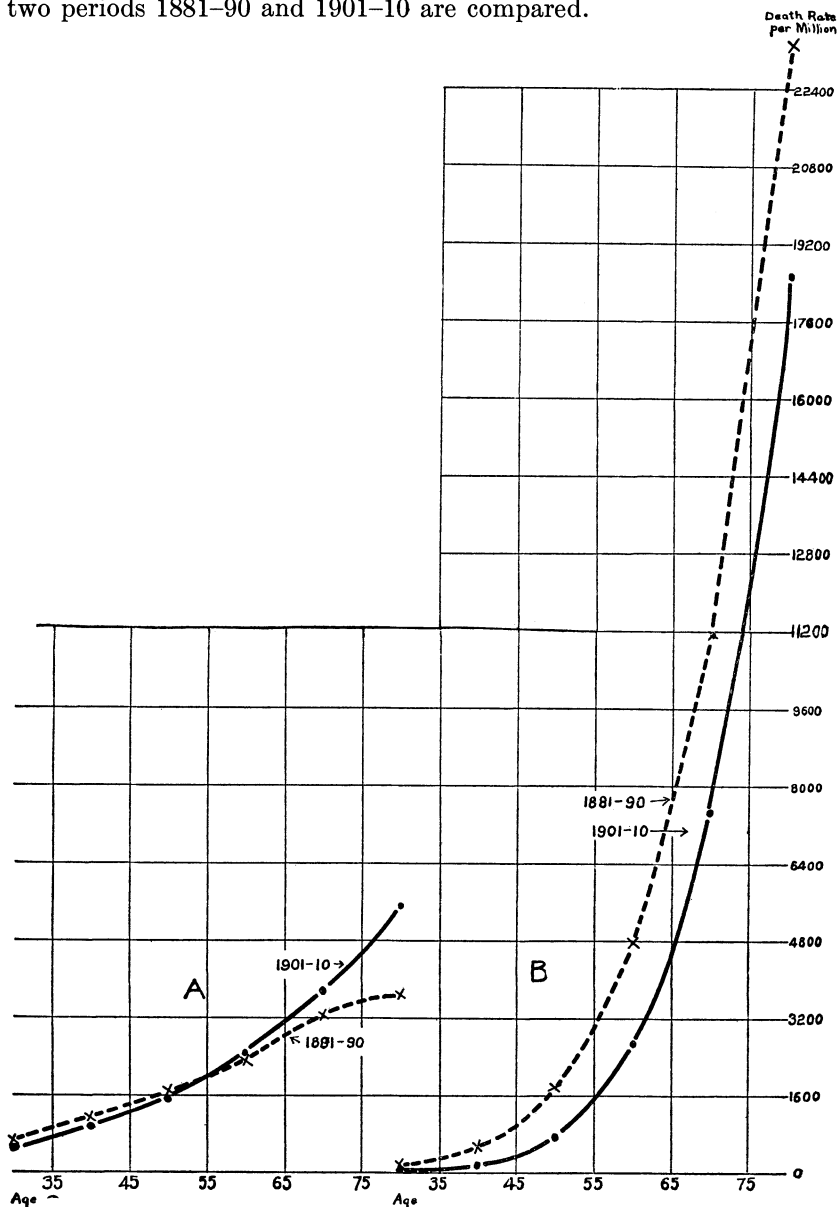


FIGURE III. DEATH RATE PER MILLION MALES AT EACH AGE PERIOD IN 1881-90 AND 1901-10 from

A. Pneumonia.

B. Bronchitis.

The decline in the male death rate from bronchitis at each age-group is noteworthy, as is also the fact that in the decennium 1901-10 the death rate from pneumonia increased only at ages 65 and upwards. Notwithstanding the increased longevity of the population in the year 1918 in England and Wales, only 3.8 per cent of the total male deaths was attributed to old age or senile decay, while in the 25 years 1848-72 the number under this heading averaged 5.1 per cent of the total deaths. Even more striking as showing changes in medical certification is the following illustration of American experience, borrowed from a paper by Dr. L. I. Dublin on "The Registration of Vital Statistics and Good Business."

#### CARDIAC AND RENAL DISEASES

These considerations apply with even greater force when historical comparisons are made of the mortality from cardiac and renal diseases, as shown for the English experiences in 1881-90 and 1901-10 respectively (Figure V). After age 45 an increase is shown in the death rate (stated in terms of the population at the ages under risk) for each group of diseases, the maximum increase being at ages 65-75 and at 75 and upwards. To what extent this increase is real, and to what extent it arises from more accurate medical diagnosis and certification of the cause of death, cannot be stated with any degree of probability; but it must be borne in mind that this increase is associated with a reduction in the death rate from all causes in the aggregate at these very ages. The only absolutely certain facts are that on the average in English experience we live longer than in the past; but such as do not die literally of old age are certified in a larger proportion than in the past as having died of circulatory and renal diseases.

#### TUBERCULOSIS

The curves of English experience in 1881-90 and in 1901-10 for tuberculosis (Figure VI) show the decline in the death rate from this supremely important disease; also the gradual postponement of the age of maximum death-toll from it. We are more immediately concerned in this paper with mortality after middle life, and the curves bring out the too little remembered fact that tuberculosis remains one of the chief causes of death right up to old age.

#### CANCER

It would require a separate lecture to discuss the question of the increase of the registered death rate for cancer (shown in Figure VI).

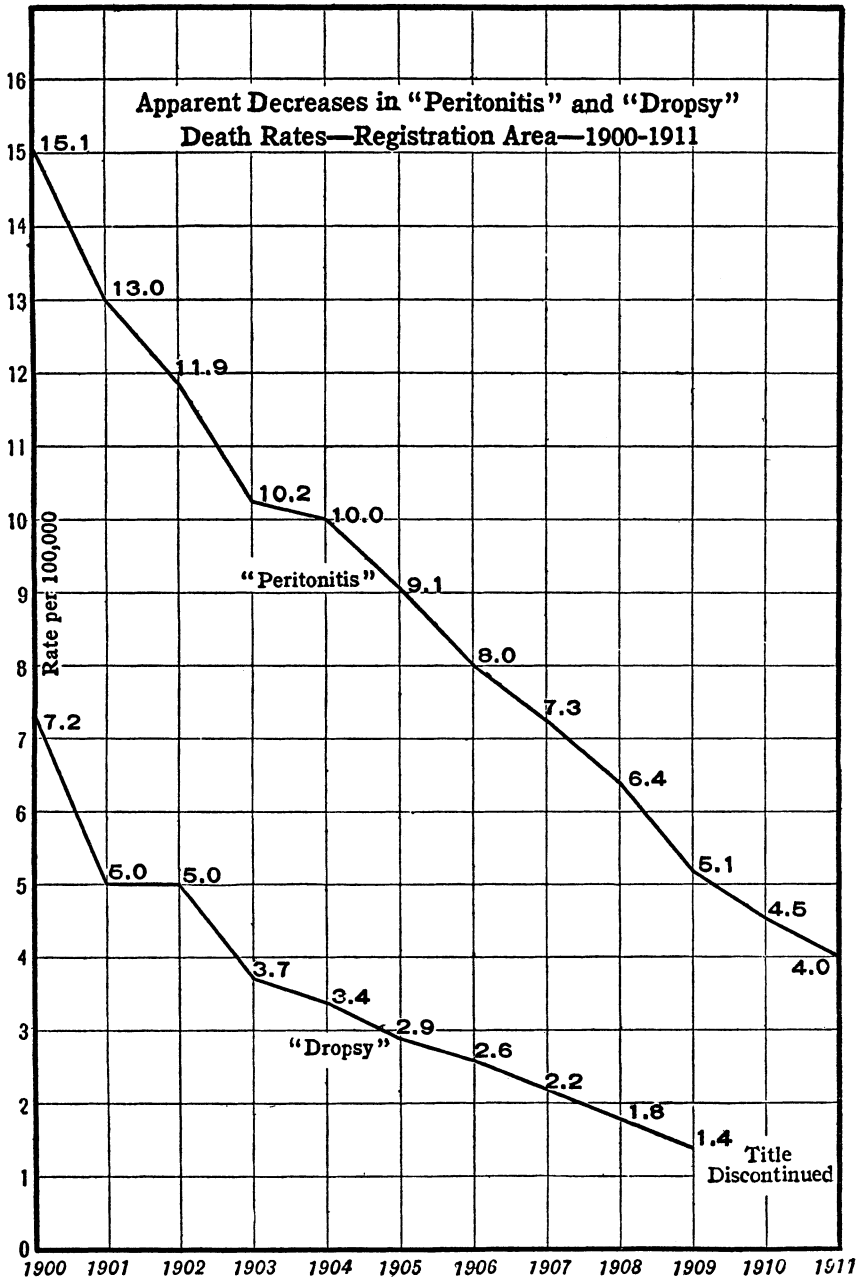


FIGURE IV. ILLUSTRATING TRANSFERENCE OF CAUSES OF DEATH

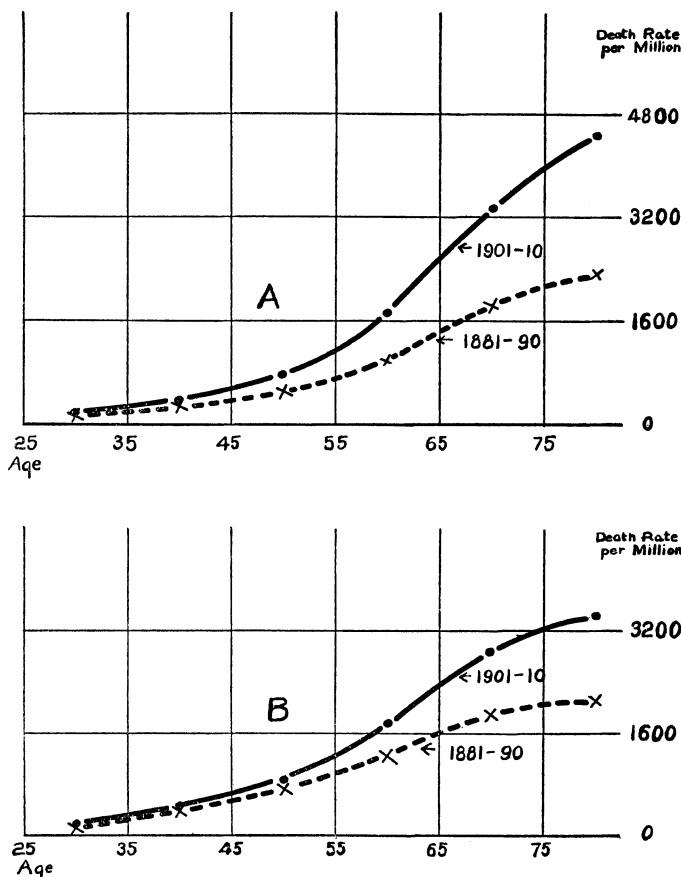


FIGURE V. DEATH RATE PER MILLION MALES AT EACH AGE PERIOD OVER 25 IN 1881-90 AND 1901-10.

A. Valvular disease of the heart, endocarditis and angina pectoris.

B. Acute and chronic nephritis, Bright's disease.

The balance of evidence appears now to support the view that cancer of certain organs has increased, although Professor W. F. Willcox, bringing up to date a paper by Mr. George King, F. I. A., and myself,\* has recently come to the conclusion tentatively reached by us in 1893.

In this earlier paper the national returns for each division of the United Kingdom were subjected to accurate analysis, and statistics were given based on the death rate of Frankfort-on-Main for 1860-89, showing the incidence of cancer according to site. The conclusion

\* "On the Alleged Increase of Cancer," Proc. Roy. Soc., Vol. 54, 1893.

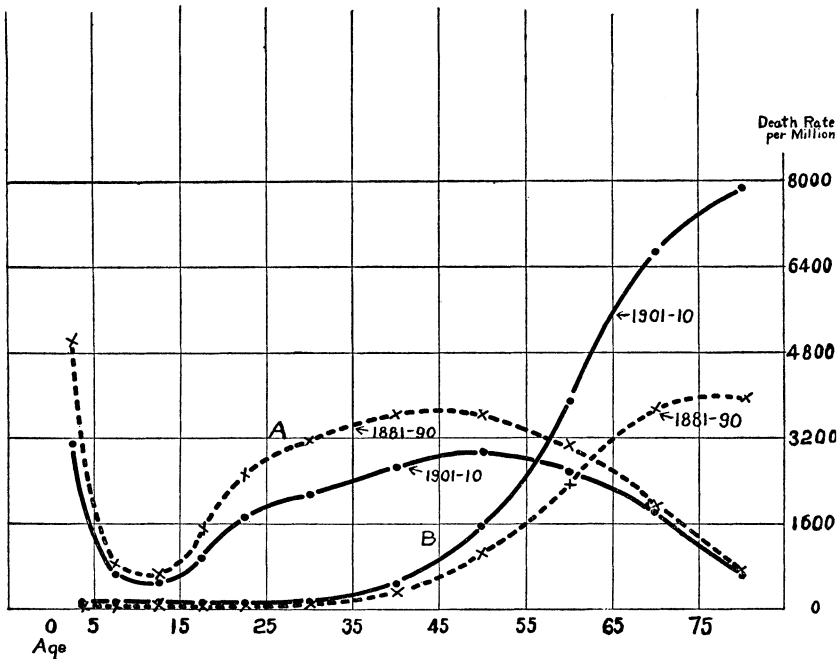


FIGURE VI. DEATH RATE PER MILLION MALES AT DIFFERENT AGE PERIODS IN 1881-90 AND 1901-10.

A. Tuberculosis (all forms).

B. Cancer.

reached was that the apparent increase of cancer is confined to "inaccessible" cancer of difficult diagnosis; and Professor Willcox has continued his comparison of cancer death rates in Frankfort down to 1913 with the result of confirming the earlier observations. The subject has been rediscussed in much detail by Dr. T. H. C. Stevenson in the annual report of the English Registrar General for 1917, in the light of English cancer data giving localization of the lesion; the conclusion he reaches is that in England "amongst males mortality from accessible cancer has increased more rapidly than from inaccessible, whereas amongst females the position is reversed, the result for both sexes jointly being a moderate excess of increase from inaccessible cancer."

In other words, the English figures do not support the conclusion drawn from the Frankfort figures, which at the time they were examined were the only figures available. Whether cancer mortality is increasing or not, the practical point is that from middle life onward it is one of the chief causes of premature mortality.

So far we have seen that a remarkable increase has occurred in the registered death rate at ages over 45 from certain diseases; and that this is associated with a declining death rate from all causes in the aggregate at these ages. The absence of a corresponding decline in the total death rate at these higher ages in the registration area of the United States is better explained by immigration of a diverse population than by the assumption that causes of degeneration are operating in the native-born population of the United States to an extent beyond that in England. Of course this does not imply that the conditions causing "degenerative diseases" do not require appropriate action in both countries. The English Registrar General in his *Decennial Supplement for 1901-10*, gives valuable tables of the death rate at various ages from 32 of the chief causes of death. From these tables the diagrams already given comparing the experience of 1881-90 and of 1901-10 for pneumonia, bronchitis, tuberculosis, cancer, and cardiac and renal diseases have been taken.

In the twenty years between the two periods the chief causes of death which showed decrease and increase respectively were as follows:

#### CAUSES OF DEATH

##### Group I. Decreasing

Smallpox  
Measles  
Scarlet fever  
Whooping cough  
Croup  
Enteric fever  
Syphilis  
Tuberculosis  
Rheumatic fever and rheumatism of the heart  
Meningitis  
Epilepsy  
Laryngitis  
Bronchitis  
Pleurisy  
Violence

##### Group II. Increasing

Influenza  
Diphtheria  
Diarrheal diseases  
Pneumonia  
Cancer  
Diabetes mellitus  
Valvular diseases of heart endocarditis  
Nephritis and Bright's disease  
Suicide

To supplement the evidence already stated, the following diagram may be studied. In A is shown the age distribution of the male death rate from all the diseases in Group I (above) in 1881-90 and in 1901-10 respectively. In B are displayed the corresponding facts for Group II; while in C is shown the age-distribution of the total male death rate from all other causes in the two decennia.

We thus see, as has already been displayed by the life-table method,

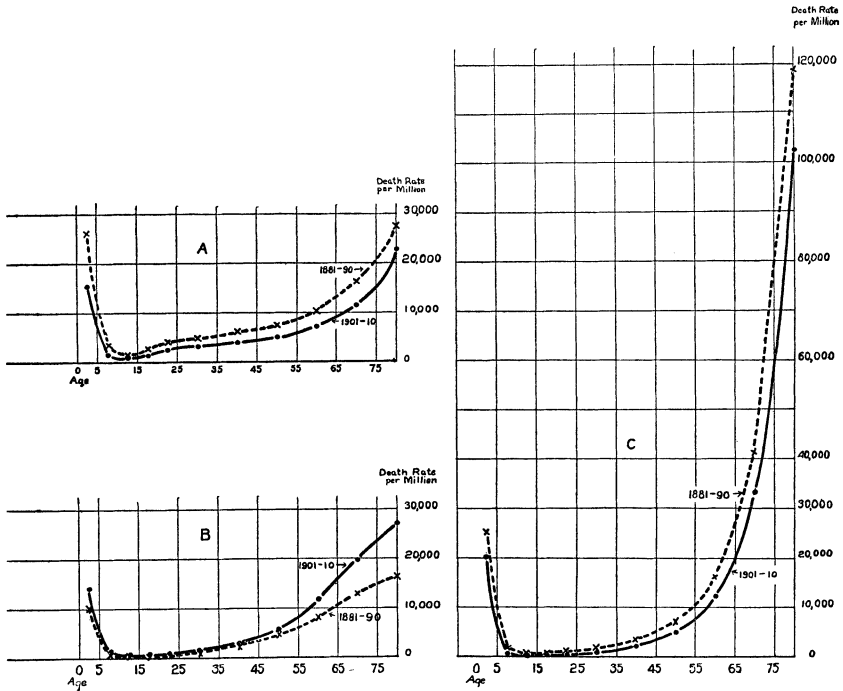


FIGURE VII. DEATH RATE PER MILLION MALES AT DIFFERENT AGE PERIODS IN 1881-90 AND 1901-10.

- A. Group of diseases with decreasing death rate.\*
- B. Group of diseases with increasing death rate.\*
- C. All other causes of death.

that the balance is on the side of gain of life. For England we must decide between three possibilities: (1) increased mortality from certain diseases in middle and advanced life has been more than counter-balanced by decreased mortality from other diseases; (2) there has been merely transference of entries owing to gradually increasing accuracy of certification of deaths; or (3) these two factors are represented in the results to an uncertain extent.

For the registration area of the United States the situation is not so clear. As in England, there has been great increase in the registered mortality from certain diseases during middle and late life. Thus, Dr. Frederick L. Hoffman in a paper on "The Mortality from Degenerative Diseases," while deprecating hasty conclusions from imperfect data gives tables from which the following extracts are taken:

\*See list on page 710.



TABLE X

PERCENTAGE INCREASE OR DECREASE IN THE DEATH RATE FROM ALL CAUSES  
AND FROM EACH OF THE FOLLOWING DISEASES BETWEEN 1900 AND 1915

	At ages				
	30-40	40-50	50-60	60-70	70-80
Apoplexy and cerebral softening.....	+29.4	+11.1	+18.8	+33.3	+39.7
Heart and arterial diseases.....	+6.3	+19.8	+30.0	+56.3	+81.7
Kidney diseases.....	+21.0	+1.8	+22.2	+43.0	+64.1
All causes.....	-22.6	-8.5	+0.9	+5.8	+4.2

The total death rate for all causes at ages over 45 has also increased among males in the registration area, though to a relatively small extent. Furthermore, the prospects of survival to old age in the registration area are on the average equal to those of the English population; and it is likely that the increased death rate from all causes and from these "degenerative diseases" is due to the introduction of foreign populations, who have lived in youth, and possibly after arrival in this country, an arduous life of overstrain under circumstances of lower civilization with excess of infectious diseases.

He would be foolish who, in view of the foregoing broad facts for the average population, committed himself to a pessimistic view as to middle and late middle life in the future either for the English or the American white population. A more favorable view, however, is not incompatible with the existence of circumstances favoring or even producing premature decay in special groups. But these circumstances do not exist or are more than counterbalanced for the mass of our populations, which chiefly determines the trend of our national statistics; and it is all the more satisfactory—especially from a public health standpoint—that this should be so, in view of the increasing trend toward city life.

#### POSSIBILITIES OF DIMINISHING DISEASES AT AGES 40 TO 70

There is ample evidence to show that apparently irrespective of modes of life, longevity is the rule in certain families, while in others, equally apart from perceptible differences in mode of life, the arteries fail prematurely. It would appear that there is no condition in which the influence of heredity is more marked than in the capacity to attain old age.

Apart from this unequally distributed inherent capacity for old age, we must, if asked to state in a single formula the most serious impediment to the attainment of old age, agree that *injury due to infections is the chief cause of mortality.*

Next to infections as a cause of premature death comes malignant disease, the most pitiless of enemies, depriving us by cruel steps of those whose ripe judgment and mature knowledge make them almost irreplaceable. It is between the ages of 40 and 60 that men begin to repay the community for the varied expenses hitherto incurred on their account. Prior to this period the balance is often on the wrong side, and it is at these ages that cancer chiefly claims its victims.

In men in England at ages 45-55, one death out of 10.5 total deaths from all causes, at ages 55-65, one death out of 8.1, at ages 65-75, one death out of 9.6, and at ages over 75 one death out of 19.3 total deaths was due, in 1901-10, to this cause. And it still remains true that although in every civilized country earnest investigators are searching for a line of action which may be hopeful if not certainly successful, at present we can only point to the avoidance of protracted local irritations, and to the early diagnosis and treatment of the disease, as means of prevention of death in a certain proportion of cases.

We must confess our almost equally great inability with respect to catarrhal infections, whether ordinary catarrhs or their more serious congeners, bronchitis and pneumonia. Apart from avenues of hope with regard to pneumococcic infections, there is little prospect of early conquest over these diseases.

Pandemic influenza, with streptococcic secondary infection, has recently proved to be a more serious cause of death than a world war, and no action for its abatement, on a large scale, has been practicable.

Tuberculosis, although capable of being reduced to a shadow of its present importance, were we prepared to invest the necessary money and energy in continuous and complete action against it, still stalks the earth and cuts off a large share of our population, especially at ages when persons are just beginning to repay their communal indebtedness. Tuberculosis is also, much more than is recognized, a common cause of death at ages over 50, either as a chronic disease, often masquerading as senile bronchitis, or as an acute complication of other diseases. As tuberculosis becomes relatively less serious, cancer more than takes its place as a cause of premature mortality.

Diseases of the heart and blood vessels form a complex group and have diverse causation. Of the evil influence of excessive muscular work, of over-feeding, alcoholism, or excessive smoking, or other unhygienic personal habits in securing prematurely senile arteries and heart, I will assume that there is no doubt; but it is practically certain that such factors are of relatively small importance as compared with the havoc played by the multiple infections to which we are subjected. The chief enemies which prevent arteries and heart from fulfilling

their duties to a robust old age are the specific infections of rheumatic fever, of syphilis, the pneumococci, and various streptococci from focal or other infections and still oftener secondary to an attack of an acute specific infectious disease.

We are now thoroughly advised of the magnitude of the mischief done by syphilis. Cerebral hemorrhage before the age of 40 or 45 may be assumed nearly always to owe its origin to this disease; and we know that more than one-tenth of the inmates of our lunatic asylums are there owing to syphilis, and die a premature death because of this infection. Will the community have the courage and wisdom to adopt the medical, police, social, and moral measures required to reduce it to insignificance?

It must be confessed that but little more appears to be known concerning rheumatic fever than when, in the Milroy Lectures for 1895,\* I showed by elaborate mortality and sickness statistics derived from the general mortality experience of different European countries, from the general notification experience of Scandinavian countries, and from the experience of large general hospitals in England and other countries, that rheumatic fever is an epidemic disease of which widespread epidemics occur at intervals of a few years, though in the intervals it is never entirely absent from most communities. I drew attention to pandemics of rheumatic fever, particularly those of 1868, of 1874-75, and of 1884. I also showed that in England the epidemic prevalence of rheumatic fever has always occurred in years of exceptional scarcity of rainfall.

The causation of renal diseases or of arteriosclerosis, apart from the influence of acute infectious diseases, is still obscure. We can, however, assert with a high degree of probability that if rheumatic fever could be avoided, if syphilis could be eliminated, and if the acute and chronic infectious diseases of childhood and youth and early manhood could be reduced to a shadow of their present dimensions, there would result an immense leap forward in the standard of health of the general community, and in the number of persons attaining a stalwart and healthy old age.

The chief and most promising line of attack on the disabling diseases of middle life and even of higher ages consists in the adoption of all known preventive and curative medical measures in childhood and in youth, adolescence and early manhood. It is chiefly in these years that the bill is incurred which has to be paid two, three, or four decades later. This does not imply, of course, that efforts made to anticipate and retard the onset of illness in older persons are fruitless. They are very desirable.

\* *Lancet*, May 9 and 16, 1895.

We have in fact a quadruple line of action open to us in securing a healthy life of physiologically normal duration:

1. To pursue the present lines of public health activities with complete efficiency, and thus reduce the prevalence of the infectious diseases (chronic and acute) which, though now controllable, are not controlled.

2. To undertake every additional line of public and private control of disease in the first twenty-five years of life which our more recent knowledge of preventive medicine shows to be practicable.

3. To adopt the same measures, as far as they are applicable, to ages over 25.

4. To follow every line of investigation which may enable us to secure further control over disease.

There can be no doubt that although every line of action indicated above must be followed to ensure success, the greatest and earliest results will be secured by a great increase of activities under the first two of these headings.

#### WITH INCREASE OF AVERAGE LENGTH OF LIFE HAS THERE BEEN IMPROVED HEALTH?

The facts already stated prove not only that out of a given number born, a larger number than formerly survive to the more useful years of life and to old age, but also that out of equal numbers taken at age 25 or even at age 40, the prospects of survival to old age have improved. Any doubt on this point, for the white population of the United States, results probably from the vast introduction of a foreign population belonging in large measure to a lower order of sanitary and social organization.

But these facts are not incompatible with the possibility that increased survival means a large amount of invalidism and inferior health in the population. Are we in the fullest sense living longer, or are we merely longer in dying? This problem cannot be discussed adequately in the present paper. I may be permitted to quote the following remarks written by me in 1893. At that time the death rate had increased in England at the higher ages, as it has recently done in the United States. But the general comments are relevant still.\*

"1. A favorite explanation of the diminished expectation of life in adult years is that owing to the saving of life in the earlier years of life—a saving which has been especially in zymotic diseases and phthisis and other tubercular diseases—there has been a larger number of

\* See Brighton Life Table, 1893, or *Elements of Vital Statistics*, p. 316.

weakly survivors, who would under the former régime have been carried off by these diseases. In other words, the operation of the law of the survival of the fittest has been impeded, with results unfavorable to the health and vigor of adult life. This argument assumes that weakly children are more prone to attack by infectious diseases than robust children, an assumption which experience does not confirm. These diseases appear to attack the majority of children, weakly or robust, who are exposed to their infection. It might be reasonably expected, therefore, that with a decrease in the total deaths from infectious diseases, there would have been at least a corresponding decrease in the number of those who are left maimed by an attack of one of these diseases to survive to adult life. I personally think that the weeding out of weakly lives, caused by the greater mortality among weakly children suffering from an infectious disease, is almost entirely counterbalanced by the greater number of children made weakly in former times by non-fatal attacks of an infectious disease.

The case for deterioration of the race by survival of patients who would formerly have died in early life from phthisis and other tubercular diseases, appears to be a stronger one. It is probable that a larger proportion of phthysical patients are cured than formerly. It is probable also that many more children with a strong tendency to phthisis or even suffering from its early symptoms are prevented by the improved medical treatment and the improved social conditions of recent years from developing the disease. These now may survive to adult life and become the parents of children with a strong tubercular tendency.

Such a fact need not, however, cause any serious apprehension for two reasons. In the first place, hereditary tendencies to phthisis act only under favorable predisposing conditions, such as damp and overcrowded houses, sedentary occupation in a cramped position, etc.; and in presence of the active exciting agent, the specific bacillus to which phthisis and other tubercular diseases are due. The exciting cause of tuberculosis is the introduction *ab extra* of the specific infection by inhalation or by means of food.

In the second place, assuming that more phthysical patients survive than formerly, is it not equally true that fewer persons *become* phthysical than formerly? With a diminution of the active cases of phthisis, the number of centers for phthysical sputum, the chief cause of subsequent infection, must have diminished to a corresponding extent. Of the fact that the predisposing causes of phthisis—damp and overcrowded houses, ill-ventilated workshops, etc.—are steadily diminishing, there is evidence on every hand. It is, therefore, reasonable to suppose that much at least of the deteriorating effect of survival of tubercular persons is counterbalanced by the large number of persons who are *prevented by improved sanitary and social conditions from becoming tubercular*.

It is premature at present to attempt by statistical means to determine how far the counteracting influences which are at work balance each other, or failing a balance, on which side is the preponderating effect.

2. The increased stress of modern life is supposed by many to explain the increased death rate among adults. It is doubtful if such increased strain exists in the community as a whole. Each adult as he becomes year by year more deeply involved in the battle of life, comes to the conclusion that the general strain of life in the community is increasing, forgetting that the same causes operated as life advanced in previous generations. There is reason for thinking with Dr. Pye-Smith that much of the evil ascribed to "over-pressure" is really due to over-feeding and drinking.

Assuming, however, that over-pressure exists in certain stations of life, *e. g.*, among city merchants, medical men, etc., it cannot be said to exist generally among professional men. Clergymen, lawyers, and civil-servants are as classes long-lived.

Even assuming that over-pressure exists throughout the whole of the professional and mercantile classes, these do not form the mass of the community. *The majority of the population of England and Wales belongs to the wage-earning classes*, and the conditions of these classes will therefore necessarily have the greatest influence on the total result.

Those conditions, as we know, have greatly improved.

I see no reason for altering the view stated in the preceding extract, except that I should now attach little if any importance to hereditary predisposition in tuberculosis, and should state my conclusions with less hesitation. Under the circumstances of modern civilization the assumption that natural selection can act as under savage conditions is completely unwarranted. Civilized life, leading to progressive improvement of environment and of personal habits, submerges any possible influence of natural selection in removing those unfit for survival, substituting for it a process of steady uplifting in fitness of the general population.

This is well illustrated in the following curves which show that infants who have escaped the assumed selective influence of a high infant mortality in infancy, continue to survive all through life in larger numbers than infants among whom excessive infant mortality has prevailed.

The recent recruiting figures have been adduced as evidence of widespread physical deterioration, and they doubtless show that both in this country and in the United Kingdom a large proportion of recruits suffered from physical defect or disease, rendering them unfit for military service. I have no wish to minimize the importance of these figures. That they indicate any deterioration in physique in the population, historically, is not proved, and is highly improbable.

In 1844 over half the recruits in Leeds were rejected; and in Birmingham and the surrounding towns in 1852 only one-third of the

	Mean Population, 1891-1900.	Mean Infant Mortality per 1,000 Births.
England and Wales .. ..	30,643,479	157
Selected Healthy Districts ..	4,477,485	109

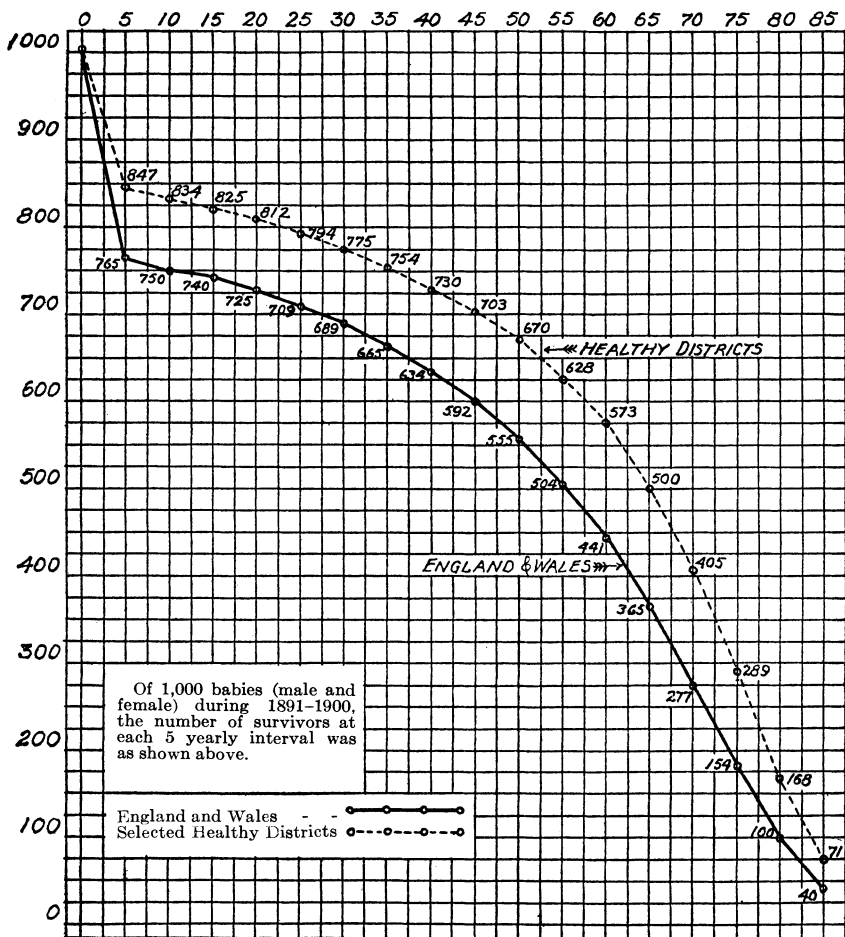


FIGURE VIII. Showing the number of survivors at each successive year of life out of 1,000 infants born in England and Wales and in selected healthy districts in 1881-90.

This table is to be read as shown in the following example:—At age 20 the number of survivors was 812 in healthy districts, 726 in the country as a whole; at age 60 was 573 in healthy districts, 441 in the country as a whole; and so on.

men who enlisted were approved. We have always thought we were a decadent race, and so have other nations before us. The ancient Greeks thought themselves to be degenerate, and the Spartans adopted the ill-considered action of exposing weakly infants to avoid this result. Sophocles is quoted by Dean Inge as stating that the best fate of man is "not to be born, or being born to die." Shakespeare refers to this "waning age" and has other similar passages. In 1721 Bishop Berkeley wrote an "essay towards preventing the ruin of Great Britain"; and you will remember Wordsworth's sonnet in which the following passage appears:

"Milton, thou should'st be living at this hour,  
England hath need of thee: She is a fen  
Of stagnant waters";

though he adds later:

"It is not to be thought of that the Flood of British freedom  
  \*       \*       \*  
That this most famous stream in bogs and sands  
Should perish; and to evil and to good  
Be lost for ever."

Every Tory Squire still believes that England is going to the dogs; but I prefer the sanguine view expressed by Tennyson as embodying the real outlook of both England and America:

"This fine old world of ours is but a child,  
Yet in the go-car."